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PROBLEMS, REPAIR METHODS, MATERIALS, AND EQUIPMENT

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FOREWORD

This investigation was conducted for the Directorate of Military Construction, Office of the Chief of Engineers (OCE), under RDT&E Project 4A062112A891 "Permanent Construction Materials and Techniques"; Task 04, "Facilities Engineering Methods and Technology"; Work Unit 003, "Waterproofing Concrete and Masonry Military Facilities." The work was performed by the Construction Materials Branch, Materials Systems and Science Division (MS), Construction Engineering Research Laboratory (CERL), Champaign, IL. OCE Technical Monitor was Mr. J. V. Blake.

This study was conducted under the general supervision of Mr. J. J. Healy, Chief of MS. Dr. G. W. Williamson is Chief, Construction Materials Branch. COL M. D. Remus is Commander and Director of CERL and Dr. L. R. Shaffer is Deputy Director.

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LEAKY SHOWER ROOMS: PROBLEMS, REPAIR METHODS, MATERIALS, AND EQUIPMENT

1 INTRODUCTION

Background. Shower room water seepage has been a persistent problem in military facilities. The water flows to adjacent areas of the building causing damage to both the structure and contents, and annoying occupants. Leakage can be from innumerable sources; the area of leakage and its source must be identified before correction is possible.

Generally, water seepage is a result of leaky pipe connections and fixtures, and condensation. Water from these sources flows to other parts of the structure through unprotected pipe penetrations, loose or open wall mortar joints (especially in corners), and defective shower pans, drains, and floors.

Objective. The objective of this was to develop information on waterproofing materials and techniques that effectively seal and waterproof leaky shower rooms, and can be used in new construction.

Approach. Initially, a letter survey of Corps of Engineers Divisions Districts, and other interested agencies was made to determine the nature of shower room water seepage problems and successful and unsuccessful remedial measures directed at solving the problems. Three installations with major seepage problems were visited to determine the needs of the facilities engineer. Seven more installations were contacted by phone. Manufacturers were contacted to obtain product information on applicable waterproofing materials and equipment. The materials were categorized by use for various phases of shower room waterproofing and repair work.

Companies mentioned in this report and their recommended products for specific uses were taken from a list of manufacturers' names compiled from advertisements in construction journals, trade associations, and referrals from various people contacted. Omission of companies does not reflect on the quality of their products; neither does inclusion indicate approval.

The selection of materials for a particular use was based on recommendations in the manufacturer's technical literature as well as on recommendations made by manufacturer's technical representatives.

Although in many cases samples were furnished, the scope of this project did not permit laboratory and field evaluations; neither did the scope include contacting users of the products listed to determine performance in the field.

2 LOCATING THE SEEPAGE SOURCE

When the source of the seepage is unknown, the initial step is to locate the source. The following sections provide some guidelines for locating the seepage source.

Piping. Seepage in the floor and ceiling below when showers are off is usually caused by leaky pipe connections and/or condensation on uninsulated pipes and ventilation ductwork. To locate the seepage source, two separate steps are required. First, successive sections of the hot and cold water piping systems are subjected to a hydrostatic pressure of 100 psi and checked for leaks.¹ Next, showers are turned on for long periods of time, and all piping and ductwork are checked for condensation. For related leakage sources, see Table 1 (Pipe Connections, Chase, and Condensation and Ventilation).

Condensation. Stains or peeling paint on a ceiling indicate that ventilation ductwork should be investigated for leaks and/or condensation forming or uninsulated ductwork. A vapor-tight or insulated duct with a vapor barrier is needed (Table 1).

Shower Floor, Pan, and Drain. If water seepage on lower floors is present only when showers are turned on, water may be passing through loose or open wall mortar joints or corners in the walls, or through the floor because of a defective floor pan or drain (Table 1).

Other defects in shower floors which can contribute to water seepage are: cracked floor tile or open joints, improperly prepared base for the pan, excessive lime in setting bed mix leading to pan corrosion, an overly thick tile setting bed with no concrete leveling course, plugged weep holes, unwaterproofed pipe penetrations through floor, and upstands not provided for all pipe penetrations through floor (Table 1, Drain and Shower Floor).

To test the shower room floor, drain, and periphery of the drain for leaks, plug the drain below the weep holes and flood the floor to a depth

¹ *Guide Specification for Military Construction, Plumbing, General Purpose, CE-300.01* (Department of the Army, March 1971), para 40.

of at least 1 in. Allow water to stand 24 hours. If the water level does not drop (except for evaporation) during the test, the floor system is satisfactory.²

A leak indicated by the above tests could be in either the pan, the periphery of the drain, or the drain. Test the drain pipe line first by plugging it in a lower section, filling the line with water to the floor level, and observing whether the water level drops and seepage occurs on lower floors.³ A red dye can be used in the water to facilitate inspection. Table 1 lists shower pan and drain leakage problems experienced in the field.

In testing for shower pan and periphery of drain leakage, a dam is built around the periphery of the drain, thus eliminating the effects of the drain. The pan is then filled with water to a minimum depth of 1 in.⁴ If, after 24 hours, the water level has dropped, the pan is leaking. Before removing the floor tile to locate the leak in the pan, plug the drain again and fill the area within the inside of the drain periphery dam with water; note if a drop in water level occurs. A leak here indicates (see Table 1, Shower Floor and Shower Pan) that several problems may exist at the drain such as: a poor junction between the shower pan (usually lead sheet) and the drain, pan damaged from the screwed-on clamp at the drain, corrosion of pan at drain, loose clamp ring screws or perforated flashing, or plugged weep holes in the shower floor bed at the drain. After draining the water, the floor tile and setting bed should be removed around the drain to determine and correct the leakage cause. If the pan also leaks, the entire tile floor and tile setting bed must be removed so the pan can be inspected and repaired or replaced.

Shower Room Walls. Water seepage at lower floors while showers are on may also be due to leaks in the shower room walls. Remove the drain plug from floor and test the wall for leakage by flooding water on it and watching for seepage at the lower floors where it was first seen. This test must be repeated at all floor levels working downwards. If the shower floor system is leaky, the wall cannot be tested until the floor leaks are repaired. The procedure for locating and repairing the floor leak is described in the section "Shower Floor, Pan, and Drain." See Table 1 for wall leakage areas.

² *Guide Specifications for Military Construction, Plumbing, General Purpose, CE-300.01 (Department of the Army, March 1971), para 11.*

³ *Guide Specifications for Military Construction, Plumbing, General Purpose, para 40.*

⁴ *Guide Specifications for Military Construction, Plumbing, General Purpose, para 11.*

3 REPAIR METHODS OR REMEDIES

Pipe Connections and Chase. Tighten loose piping, replace worn parts, make repairs, clean out plugged piping, provide waterproofing where necessary, and modify or redesign as required (see Table 1). The chase requires flashing sleeves, upstands, and waterproofing at pipe penetrations through the floor. Vent pipe requires a flashing sleeve in chase.

The following recommendations for handling leaks originating in piping came from the field letter survey:

- a. Remove all branch piping from ceiling area in shower rooms. This eliminates sources of leaks and potential for condensation.
- b. Reroute water supply lines to shower from upfeed to downfeed thus decreasing floor penetration in pipe chase, and extend waterproofing membrane across pipe chase and under shower pans.
- c. Use fixed shower heads, which are less likely to develop leaks.
- d. Exposing the piping of hot and cold water feed lines, connecting lines, and shower heads is proving helpful in reducing maintenance problems. There is, however, the risk of damage by barracks occupants.
- e. To prevent damage to ceilings from leaky overhead pipes, use nonabsorbing ceiling materials such as aluminum perforated pans. This will also provide convenient access to the suspended ceiling area for future maintenance.
- f. Gypsum plaster is not recommended for areas subjected to high humidity.

Respondents also recommended that the floor of the pipe chase be waterproofed and the chase treated as a waterproofed area complete with a drainage system.

Condensation and Ventilation. Lower joints of the exhaust ductwork should be soldered watertight and a 5/8-in. copper drain installed at the low point. Exhaust fans should be operating, exhausting more air from shower rooms.

Shower Room Walls. Difficulty has been experienced in removing loose mortar and cleaning joints to make permanent repairs. Common tools for routing tile joints are a bent front-file or beer can opener. Table 2 lists materials recommended by manufacturers for repair of nonmoving grout cracks (No. 1-7), moving grout cracks and joints (No. 8-17), and wall tile grout (No. 18-30). The following materials for use in wall restoration or renovation are also listed in Table 2: binder or adhesive

additives for grout or mortar (No. 38-42), ceramic wall tile adhesives (No. 51-52), tile-on-tile adhesives (No. 53, 54, 56), shower wall coatings and restoration work (No. 63-75), and shower wall panels (No. 103).

The following recommendations from the field and past studies are proposed to solve the wall seepage problem when repair of mortar joints is inadequate:

- a. Use coved glazed structural facing units (GSFU) in corners, rather than butted corners.
- b. If glazed structural units (GSU) in shower areas are not replaced, the vertical interior corner joint in the partition walls should be raked and sealed with a suitable flexible waterproof caulking (see Table 2, No. 8-17).
- c. Use conventional ceramic tile construction with a setting bed and membrane moisture barrier for shower room finish.
- d. Use of ceramic tile should be required and use of GSU prohibited below the 7 ft wainscot height for shower rooms.
- e. Use GSFU thicker than 2 in. to prevent water passage to lower floors (insufficient head and bed joints).
- f. In new construction with GSFU, use dense waterproof mortar joint material such as epoxy resin or appropriate mortar.
- g. Coat or waterproof the wall (see Table 2, No. 63-75).
- h. Coat walls periodically with a 5 percent or stronger silicone solution to prevent leakage.
- i. Use plastic wall panels (see Table 2, No. 103).
- j. Use individual shower room modules (see Appendix, Table A-1).

Shower Pan and Drain. Leaks can occur at the drain junction or any other area of the pan (Table 1, Drain and Shower Pan). The leak source test described above can identify the areas of leakage. If the leak is only at the drain, the floor tile and setting bed in this area should be removed and the defect repaired. Other leakage in the pan should also be repaired unless the pan is so deteriorated that it must be replaced. A new lead (or other type) pan and drains recommended by manufacturers can be used as listed in Table 2 (materials for waterproofing and protecting shower pan or for use under pan, No. 77-88; shower pan materials, No. 89-98; and shower floor drains, No. 104-108).

The following are recommendations proposed by the respondents of the field letter survey and by past studies to solve shower pan leakage problems:

- a. Use a minimum asphalt coating of 1/32 in. on pan.
- b. Use a hot bituminous asphalt instead of roofing asphalt for coating pan.
- c. Remove floor to depth of lead pans. Apply three-ply 15-lb asphalt felt with 15-lb felt strip starter sheet around the perimeter, all keyed with asphalt mastic into the existing concrete screeds around the perimeter of the showers.
- d. Add 12 percent fibrous material to the asphalt coating.
- e. Shower pan should be large enough to intercept wall and pipe fitting leakage; otherwise water will accumulate in floor under pan and leak.
- f. Use nonmetallic pan in future (Table 2, No. 89-94, 96, 97).
- g. Butyl rubber membrane waterproofing instead of lead pan is suggested. Concrete floor must be smooth, or butyl may be punctured.
- h. Use Compotite instead of a lead pan. (This is a prefabricated composite consisting of eight-ply kraft paper bonded and saturated by seven layers of asphalt, reinforced with three layers of glass fibers, with a polyethylene facing sheet [Table 2, No. 92]. The product has disadvantages in that it is inflexible, hard to fold to make corners, and stiff at low temperatures.)
- i. Make critical inspection of lead pan and coatings during construction.
- j. At drain, use nonmetallic flashing instead of lead.
- k. At drain, use epoxy/nylon sealant for appropriate leaks. Do not use this in new construction due to possible damage from settlement.
- l. Eliminate the corrosion problem at shower floor drain by using a plastic or polyethylene drain (Table 2, No. 107, 108).

Shower Floor. Shower floor leakage is caused principally by leaky pans and drains, lack of waterproofing protection at pipe penetrations through the floor, plugged weep holes, insufficient turn-up or no turn-up of the edges of the pan, poor workmanship, and excessive use (Table 1, Shower Pan). If such multiple defects are combined with a deteriorated floor, the tile setting bed and floor must be replaced. Where only the floor is deteriorated, the bad sections should be cut out, the area remortared, and new tile placed and regouted using fresh water-resistant materials with good adhesion to the floor tile. Table 2 lists materials recommended by manufacturers for repair of nonmoving grout cracks (No. 1-7),

moving grout cracks and joints (No. 8-17), and floor tile grout (No. 18-22, 31-37). The following materials listed in Table 2 are recommended for floor restoration or renovation: binders or adhesive additives for grout or mortar (No. 38-42), ceramic floor tile adhesives (No. 47-52), tile-on-tile adhesives (No. 53, 55, 56), floor resurfacing (No. 57-62), floor tile coating (No. 74-75), and floor seal coating (No. 76).

The following recommendations from past field studies are designed to solve floor leakage problems:

- a. Cracked floor tile or open joints must be regouted.
- b. An improperly prepared base for the pan must be repaired and smoothened so that the pan is not punctured.
- c. Where the tile setting bed is too thick and no concrete leveling course was used, the inspector must assure that contract documents are followed in future new construction or maintenance work.
- d. Excess time in the setting bed mix must be avoided to prevent corrosion of lead pans.
- e. Weep holes must be protected during construction of the shower floor to avoid plugging. This can be done by inserting wires in the holes, covering them with flashing, and then removing the wires when construction is complete. Protection of the weep holes from mortar at the drain area can also be provided by using broken stone or tile around the drain.
- f. Upstands should be provided for all pipe penetrations through the floor. The circumferential space between the pipe and the upstand should be sealed with elastomeric sealant and flashing provided.

Disinfectants, Detergents, Deodorants, and Fungicides. Table 2, No. 99-102 presents disinfectants, detergents, deodorants, and fungicides recommended for shower room use by the manufacturers.

Other Types of Shower Equipment and Plastic Units. Manufacturers of glass-fiber-reinforced plastic shower and tub units, multi-shower equipment, and metal and plastic shower room drains are listed in the Appendix.

4 SUMMARY

Shower room water seepage is a persistent problem in military facilities. This report has identified causes of shower room leaks and suggested methods for locating sources of leakage. A field survey of Corps of Engineers Districts identified many types of water seepage problems. Remedial measures recommended by the survey respondents have been incorporated in the report,

along with materials recommended by manufacturers for the various types of repairs and for use in reconstruction of walls and floors in shower rooms.

TABLE 1
Shower Room Leakage Problems
Leakage Source and Area of Leakage

Pipe Connections	Area of Leakage*				
1. Loose or leaky pipe fittings	A	B	C	D	E
2. Leaking overhead pipes (drain, floor and pan)	A	B	C	D	E
3. Shower heads dripping, leaky shower connections or broken arm	A	B		D	E
4. No flashing or caulking at pipe penetrations through floor or pan	A	B		D	E
5. Crushed sleeve where supply lines penetrate pan	A	B		D	E
6. Upstands not provided for all pipe penetrations of floor	A	B		D	E
7. No waterproofing between pipe and upstand	A	B		D	E
8. Vent pipe with no flashing sleeve in chase	A	B		D	
Chase					
1. Chase not waterproofed	A	B		D	
2. Lack of drainage system in the chase	A	B		D	

* Area of Leakage

A. Chase	D. Ceiling Below
B. Wall	E. Floor
C. Ceiling	

TABLE 1 (cont'd)

Condensation and Ventilation	Area of Leakage*			
1. Condensation and lack of ventilation in shower room	A	B	C	D
2. Exhaust fan not used or inoperable	A	B	C	D
3. Condensation in chase	A	B		D
Wall				
1. Open mortar joints, cracked or loose tile or glazed structural units	A	B		D
2. Open mortar joints at butted corners	A	B		D
3. No membrane barrier in shower room walls	A	B		D
4. Chase adjacent to leaky wall	A	B		D
5. Water leak through wall, not intercepted by pan	A	B		D
6. Wall too thin	A	B		D
7. Water seepage through wall to outside of building		B		
8. No caulking at pipe and fixtures penetrating wall	A	B		D

* Area of Leakage

A. Chase	D. Ceiling Below
B. Wall	E. Floor
C. Ceiling	

TABLE 1 (cont'd)

Drain	Area of Leakage [*]			
1. Shower drain - loose clamping screws or perforated flashing	A	B	D	E
2. Leak from periphery of drain				
3. Plugged weep holes at drain				
Shower Floor				
1. Cracked floor tile or open joints and defective pan or drain				
2. Improperly prepared base for pan				
3. Tile setting bed too thick, no concrete leveling course				
4. Setting bed mix contains excessive amount of lime leading to pan corrosion	A	B	D	E
5. Plugged weep holes in shower floor at drain				
6. Upstands not provided for all pipe penetrations of floor				
7. No flashing or caulking at pipe penetrations through floor or pan				
8. Excessive use				

^{*} Area of Leakage

- | | |
|------------|------------------|
| A. Chase | D. Ceiling Below |
| B. Wall | E. Floor |
| C. Ceiling | |

TABLE 1 (cont'd)

Shower Pan	Area of Leakage*
1. Pan too small to intercept leakage in wall partition or floor	
2. Failure to upturn edges of pan	
3. Lead pan too thin	
4. Perforated or punctured pan	
5. Lack of sufficient asphalt waterproofing on pan	
6. Waterproofing application to pan - technique poor	
7. Junction of lead shower pan and shower drain	
8. Damage to pan from screwed-on clamping device at drain	A B D E
9. Corrosion of lead pan at drain from galvanic action and excess lime	
10. Leaks from penetration of lead pan to accommodate bolts and support hangers	
11. No flashing or caulking at pipe penetrations through floor or pan	
12. Crushed sleeve where supply lines penetrate pan	
13. Pans damaged after removal, repair, and replacement	
14. Lack of critical inspection during construction of lead pan and coating but specifications good	

* Area of Leakage

A. Chase	D. Ceiling Below
B. Wall	E. Floor
C. Ceiling	

TABLE 2

Leaky Shower Room
Repair Materials

Use	Number	Trade Name	Type of Product	Manufacturer*
Nonflexible				
Grout Cracks (Nonmoving)	1	Chemex Aqua-Poxy W.P.	Polyamide/Epoxy, Water Base	American Chemex, Inc.
	2	Chem Bond	Epoxy and Filler	Con/Chem, Inc.
	3	Epocast 8114 A/B	Epoxy, Porous Floor, Paint	Furane Plastics, Inc.
	4	Epocast 530 and 9816 Hardener	Epoxy for Floors	Furane Plastics, Inc.
	5	Epibond 150 A/B	Epoxy Paste for Walls	Furane Plastics, Inc.
	6	Multi Mortar	Epoxy/Polyamide	Poly Resins
	7	Epotox 350	Epoxy/Polysulfide	Toch Brothers Div., Carboline Co.
Caulking Materials - Flexible - One Component				
Grout Cracks (Moving) and Joints	8	Con/Elast H	Hypalon	Con/Chem., Inc.
	9	Silite 100	Silicone Rubber	Devcon Corp.
	10	Dow Corning 784 Interior Sealant	Silicone Rubber, for Porous Surfaces	Dow Corning Corp.
	11	Dow Corning 785 Interior Sealant	Silicone Rubber, for Nonporous Surfaces	Dow Corning Corp.
	12	Tec Tub and Tile Sealant	Acrylic	H. B. Fuller Co. (TEC)
	13	Silicone Sealant SCS-1702	Silicone Rubber	General Electric Co.
	14	Latex Caulk	Acrylic	B. F. Goodrich Industrial Products Co.

* Manufacturers' addresses are provided in the Appendix

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Grout Cracks (Moving) and Joints (cont.)	15	Macco Tub Calk	Acrylic	Macco Adhesives, Glidden-Durkee
	16	A-116 A Tub and Tile Calk	Vinyl Latex	Pecora Corp.
	17	862 Architectural Sealant	Silicone	Pecora Corp.
NOTE: Polysulfide types meeting Interim Federal Specification TT-S-00227E for multi-component elastomeric-type sealing compounds are also good but are not included here because professional applicators are required. Use where temperature is below 150°F.				
Tile Grout, Walls and Floors	18	Tile Grout, Wall or Floor	Portland Cement, Filler and Binders	Bondex International, Inc.
	19	Durok BC	Liquid Vinyl Copolymer*	Durok Building Materials, Inc.
	20	PG-2089	Epoxy/Polyamide and Sand	Permagile Corp. of America
	21	Adbond 601 A/B	Epoxy/Polyamide and Filler	Poly Resins
	22	Tite-Bond	Portland Cement/Acrylic Latex	Preco Chemical Corp.
Wall Tile Grout	23	TEC Latex Grout 600, Walls	Polyvinyl Acetate, Silica Flour	H. B. Fuller Co. (TEC)
	24	A-132 White Dry Ceram. Wall Tile Grout	Not stated	Pecora Corp.

* Add portland cement and sand.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Wall Tile Grout (cont.)	25	Wall-Nu	Epoxy/Amido Amine and Fillers	Steelcote Mfg. Co.
	26	L&M Acid-R Grout, GSU Walls and Floors	Modified Portland Cement and Quartz	L&M-Surco Mfg., Inc.
	27	Struct. Glazed Unit Grout	Modified Portland Cement and Quartz	L&M-Surco Mfg., Inc.
	28	L&M Dry Cure Grout, Wall Tile	Portland Cement and Limestone	L&M-Surco Mfg., Inc.
	29	Dry-Set Grout 9405-E, Wall Tile	Portland Cement and Additive	United States Ceramic Tile Co.
	30	Tile-Mate Dry Tile Grout, Walls	Portland Cement and Additives	USM Corp., Upco Chemical Div.
Floor Tile Grout	31	Epoxy-E-Set Setting Bed and Grout	Epoxy	Cambridge Tile Mfg. Co.
	32	TEC Latex Grout 600, Floors	Polyvinyl Acetate, Silica Flour	H. B. Fuller Co. (TEC)
	33	GL-131 Gray Latex Ceram. Floor Tile Grout	Latex and Portland Cement	Pecora Corp.

* For glazed ceramic tile.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Floor Tile Grout (cont.)	34	WL-131 White Latex Ceram. Floor Tile Grout	Latex and Portland Cement	Pecora Corp.
	35	L&M Epoxy Grout and Mortar	Epoxy	L&M-Surco Mfg., Inc.
	36	One-Part Flexible Grout, 9440	Portland Cement, Sand and Additives*	United States Ceramic Tile Co.
	37	Hydroment Filler and Grout	Portland Cement, Quartz and Additives**	USM Corp., Upco Chemical Div.
Binders or Adhesive Additives for Grout or Mortar	38	Hydr Epoxy 260	Epoxy/Polyamide, Filler, Additive	Acme Chemicals, Div. of Allied Products
	39	Camcrete C-600 Latex Mortar Additive	SBR Type Rubber Latex***	Cambridge Tile Mfg. Co.
	40	Dur-A-Poxy 200	Epoxy/Polyamide Paint †	Dur-A-Flex, Inc.
	41	Durok BC	Liquid Vinyl Copolymer ††	Durok Building Materials, Inc.
	42	TEC Tile Bond	Polyvinyl Acetate***	H.B. Fuller Co. (TEC)

* No soaking of tile joints necessary.

** Also for GSU walls.

*** For cement base type materials, not acrylic or latex.

† Add white portland cement.

†† Can also be used for adhering new tile to old tile in restoration work.

Add portland cement and sand to Durok BC.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Ceramic Wall Tile Adhesives	43	Camset C-120 Ceramic Wall Tile Adhesive	Rubber, Solvent Type	Cambridge Tile Mfg. Co.
	44	Miracle MA 400	Synthetic Rubber Type**	Miracle Adhesives Corp.
	45	A-100 Ceramic Wall Tile Adhesive	Rubber Base	Pecora Corp.
	46	W-400 Adh. for Ceramic Wall Tile	Rubber Base	United States Ceramic Tile Co.
Ceramic Floor Tile Adhesives	47	Camset C-130 Ceramic Floor Tile Adhesive	Rubber, Solvent Type	Cambridge Tile Mfg. Co.
	48	Miracle MA 500	Synthetic Rubber Type*	Miracle Adhesives Corp.
	49	A-135 Ceramic Floor Tile Adhesive	Rubber Base	Pecora Corp.
	50	F-300 Adh. for Ceramic Floor Tile	Rubber Base	United States Ceramic Tile Co.
Ceramic Tile Adhesives Floors and Walls	51	Camset C-150 Epoxy Adhesive	Epoxy with Filler	Cambridge Tile Mfg. Co.
	52	Durok BC	Liquid Vinyl Copolymer**	Durok Building Materials, Inc.

* Can also be used for adhering new tile to old tile in restoration work.
Add portland cement and sand to Durok BC.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Restoration Work Tile-on-Tile Adhesives	53	Durok BC, Walls or Floors	Liquid Vinyl Copolymer [*]	Durok Building Materials, Inc.
	54	Miracle MA 400, Walls	Synthetic Rubber Type	Miracle Adhesives Corp.
	55	Miracle MA 500, Floors	Synthetic Rubber Type	Miracle Adhesives Corp.
	56	U-Poxy	Epoxy/Polyamine, Mineral Filled	USM Corp., Upco Chem- ical Div.
Restoration Work Floor Resurfacing	57	Fibre/Crete	Epoxy/Polyamide, Glass Fiber	Con/Chem, Inc.
	58	Durepok	Epoxy - Trowelable	Durok Building Materials, Inc.
	59	Promdek Membrane with Selbatex 200	Built-Up System With Varied Finish	Selby, Battersby and Company
	60	Floor-NU	Epoxy/Amido Amine, and Sand	Steelcote Mfg. Co.
	61	Polytok Deck Coating 131	Polyurethane, 2-Comp. ^{**}	Toch Bros. Div., Carboline Co.
	62	Polytok Finish 135	Polyurethane, 2-Comp. ^{**}	Toch Bros. Div., Carboline Co.
Shower Wall Coatings and Restoration Work	63	Anchor Masonry Surfacer	Portland Cement Base and Latex, Trowel Grade	Anti-Hydro Water- proofing Co.

^{*}

^{**}Add sand.

Used together as a two-coat system.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Shower Wall Coatings and Restoration Work (cont.)	64	Seamless Deck Membrane	Urethane/Bitumen, Trowel Grade**	Anti-Hydro Water-proofing Co.
	65	Cono/Plex	Epoxy/Polyurethane	Con/Chem, Inc.
	66	Glid Tile Epoxide Block Filler No. 5512	Epoxy/Ester Acrylic** Emulsion, 1-Comp.	Glidden Coatings and Resins
	67	Glid Tile 100	Epoxy/Polyamide, 2-Comp.	Glidden Coatings and Resins
	68	Mobil-Tile Fill Coat 99-X-1	Epoxy/Polyamide***	Mobil Chemical Co.
	69	Mobil-Tile Body Coat 99-X-2	Epoxy/Polyamide***	Mobil Chemical Co.
	70	Mobil-Tile Glaze Coat -99	Epoxy/Polyamide***	Mobil Chemical Co.
	71	Urabond 836-S	Urethane Elastomeric Coating +	Poly Resins and Tremco Mfg. Co. (Distributor)
	72	Porcelain Glaze	Epoxy/Polyester	Preco Chemical Corp.
	73	Wall-Nu	Epoxy/Amido Amine and Fillers ++	Steelcote Mfg. Co.

* Use epoxy 100 percent solids top coat or apply furring strips over membrane; then retile walls.

** Use as fill coat on interior, new concrete block, prior to finishing with Glid-Tile 100.

*** Three-coat system for concrete block, poured concrete, and plasterboard.

+ Requires top coat of Procoat 372, glaze coat (Poly Resins).

++ Requires top coat of Tile-X 2000 (Steelcote).

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Shower Wall and Floor Tile Coatings	74	Armor-Weld No. 179 Glaze Finish	Epoxy/Polyamide	Missouri Paint and Varnish Co.
	75	Tile-Cote	Epoxy/Polyamide*	Wilbur and Williams, Div. of Carpenter- Morton Co.
Shower Floor Seal Coating	76	Seamless Deck Membrane	Urethane/Bitumen**	Anti-Hydro Water- proofing Co.
Waterproofing and Protecting Shower Pan or for Use Under Pan	77	Sure-Seal Neoprene Sheet Membrane	Neoprene	Carlisle Tire and Rubber Div.
	78	Sure-Seal Butyl Sheet Membrane	Butyl	Carlisle Tire and Rubber Div.
	79	Polydek	Polyurethane, 2 Comp.	Chem-Masters Corp.
	80	Durok Rubbercoat	Neoprene/Hypalon Liquid	Durok Building Materials, Inc.
	81	Nervastrol Sheetting	Elastomeric	Rubber and Plastics Compound Co., Inc.
	82	hlm 1300	Polyurethane, Trowel Grade	Sonneborn - Contech
	83	hlm 2000	Elastomer, Trowel Grade	Sonneborn - Contech
	84	Butyliner	Butyl Rubber Sheetting	Sonneborn - Contech
	85	Liquid Membrane	Resinous Polymer Liquid	L&M-Surco Mfg., Inc.
	86	Thiokol 411 Elasto- meric Membrane	Polysulfide, Liquid	Thiokol Chemical Corp.

* Use primer first, then Tile-Coat #1224 (Wilbur & Williams). If coarse masonry (block, etc.) apply fill-coat of Mason-Cote #3751 first, then primer and Tile-Cote.

** Apply top coat of 100 percent epoxy system.

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Waterproofing and Protecting Shower Pan or for Use Under Pan (cont.)	87	Thio-Deck Membrane	Polyurethane/Bitumen	Toch Bros. Div., Carboline Co.
	88	Tremproof-90	Rubberized Bitumen	Tremco Manufacturing Co.
Shower Pan Materials	89	Amelco Waterproofing	Neoprene/Asphalt Built-Up System	American Elastomers Co., Inc.
	90	Neoplex N	Polychloroprene, Compounded Base Coat*	Chem-Masters Corp.
	91	Neoplex H	Chlorosulfonated Polyethy- lene, Top Coat*	Chem-Masters Corp.
	92	Compotite Shower Pan	Laminated Asphalt, Paper, Glass Fibers	Compotite Shower Pan
	93	Vinyl Water Barrier	Polyvinyl Chloride Sheet	B.F. Goodrich Industri- al Products Co.
	94	Saraloy 240	Chlorinated Polyethylene Sheet**	Noble Co.
	95	Sandell Lead/Copper	Copper Encased in Lead and Asphalt Saturated Fabric	Sandelli Manufacturing Co.
	96	Hydrocide Vinyl Seal	PVC Sheet, Asbestos Laminated	Sonneborn - Contech

* Use together as a system.

** For more information see S. M. Kanarowski, *Evaluation of Saraloy 240 as a Waterproofing Liner for Shower Pans*, Letter Report M-34 (Construction Engineering Research Laboratory, January 1973).

TABLE 2 (cont'd)

Use	Number	Trade Name	Type of Product	Manufacturer
Shower Pan Materials (cont.)	97	Tremproof Liquid Polymer	Polymer, Tar-Modified	Tremco Manufacturing Co.
	98	Lead Pan Sheeting	Lead	Generally available
	99	Hillyard Clean-O-Lite	Dimethyl benzyl ammonium chloride	Hillyard Chemical Co.
	100	Hillyard Hi-Phene	Modified Phenolic	Hillyard Chemical Co.
Disinfectants, Detergents, Deodor- ants, Fungicides	101	Hillyard Re-Juv-Nal	Dimethyl benzyl ammonium chloride	Hillyard Chemical Co.
	102	Bacteriostatic Grout Additive	Selected Chemical Additive	L&M-Surco Mfg., Inc.
Shower Wall Panels (Can be used over tile)	103	Panel System 202	Formica Laminated Plastic and Foam	Formica Corporation
	104	Floor and Shower Drain	Metal	Blake Division, Hoffman Specialty Mfg., Corp.
Shower Floor Drains	105	Instant Set, Adjustable Drain	Metal	Frank Pattern & Mfg.
	106	Josam Floor Drain	Metal	Josam Manufacturing Company
	107	Nalgene	Polyethylene	Nalgene Piping Systems Div.
	108	GSR Plastic Shower Drain	ABS or PVC Plastic	R & G Sloane Manufacturing Co., Inc.

APPENDIX

MANUFACTURERS' ADDRESSES

Table A1 lists 10 manufacturers of glass-fiber-reinforced plastic shower and tub units, their addresses, and phone numbers. Table A2 contains similar information on manufacturers of shower equipment, including multi-showers. Table A3 gives addresses and phone numbers of the manufacturers of the 108 materials in Table 2. The numbers in Table A3 correspond to the numbers in the second column of Table 2.

TABLE A1

Glass-Fiber-Reinforced Plastic Shower and Tub Units

<u>Manufacturer</u>	<u>Glass-Fiber-Reinforced Plastic Units</u>
1. American Standard Architectural Products Dept. P. O. Box 3 33 Circle Drive North Piscataway, NJ 08854 (201-469-3000)	Shower Modules
2. Borg Warner Plumbing Products 201 East Fifth Street Mansfield, OH 44901 (419-522-4211)	Shower Modules
3. Crane Co. 300 Park Ave. New York, NY 10022 (212-752-3600)	Unette Modular Bathroom
4. Eljer Plumbingware Div. Wallace-Murray Corp. 3 Gateway Center Pittsburgh, PA 15222 (412-471-2402)	Modular Bath System
5. Federal Huber Co. 200 East Ontario Street Chicago, IL 60611 (312-787-4650)	Bathtubs, etc.
6. Kilgore Ceramics Corp. Box 1502 Kilgore, TX 75662 (214-984-3525)	Shower and Bathroom Modules
7. Kohler Co. Kohler, WI 53044 (414-457-4441)	Fiberglass Bathing Modules
8. Moen Division of Stanadyne 377 Woodland Ave. Elyria, OH 44035 (216-323-5481)	Bathroom Module

TABLE A1 (cont'd)

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|-----|--|------------------------------|
| 9. | Owens-Corning Fiberglas Corp.
Fiberglas Reinforced Components
Home Building Products Div.
Fiberglas Tower
Toledo, OH 43659
(419-259-3000) | Shower System |
| 10. | Universal-Rundle Corp.
217 North Mill Street
P. O. Box 960
New Castle, PA 16101
(412-658-6631) | Bathtubs and Bathtub Showers |

TABLE A2
Multi-Shower Equipment

Shower Equipment	Manufacturer		
	Acorn Engineering Company	Bradley Washfoun- tain Co.	Logan Mfg. Co.
Column Showers	X	X	X
In-Line Multi-Showers	X	X	X
Surface or Wall Multi-Showers	X	X	X
Private and Without Inclosures	X	X	X
Exposed Piping Showers	-	X	X

1. Acorn Engineering Co. (213-336-4561)
15058 Proctor Ave.
P. O. Box 3365
City of Industry, CA 91746
2. Bradley Washfountain Company (414-251-6000)
P. O. Box 309
Menomonee Falls, WI 53051
3. Logan Manufacturing Co. (213-244-7261) Plumbing Dept.
P. O. Box 111
Glendale, CA 91740

TABLE A3

Shower Room Repair Materials
Manufacturers' Addresses
(For Table 2)

- | | |
|--|--|
| <p>1. American Chemex, Inc.
2729 E. Ponce DeLeon Ave.
Decatur, GA 30030
(404-373-8274)</p> <p>2. Con/Chem, Inc.
15524 South Broadway
Gardena, CA 90247
(800-421-1266) Toll Free
(213-770-0044) From CA
Phones, Call Collect.</p> <p>3. Furane Plastics, Inc.
4. 5121 San Fernando Rd. West
5. Los Angeles, CA 90039
(213-247-6210) or
P. O. Box 791
Rahway, NJ 07065
(201-499-2551)</p> <p>6. Poly Resins
11655 Wicks Street
Sun Valley, CA 91352
(213-875-0820) or
(213-768-6600)</p> <p>7. Tock Brothers Division
Carboline Company
350 Hanley Ind. Ct.
St. Louis, MO 63144
(314-644-1000)</p> <p>8. See 2.</p> <p>9. Devcon Corp.
Danvers, MA
(617-777-1100)</p> <p>10. Dow Corning Corp.
11. Midland, MI 48640
(517-636-8000)</p> <p>12. H. B. Fuller Co.
Technical Adhesives Div.
315 South Hicks Rd.
Palatine, IL 60067
(312-358-9500)</p> | <p>13. General Electric Co.
Silicone Products Dept.
Waterford, NY 12188
(518-237-3330)
ext. 203, 202</p> <p>14. B. F. Goodrich Industrial
Products Co.
500 South Main Street
Akron, OH 44318
(216-379-2904)</p> <p>15. Macco Adhesives Division
Glidden-Durkee
30400 Lakeland Blvd.
Wickliffe, OH 44092
(216-943-6161)</p> <p>16. Pecora Corp.
17. 165 Wambold Road
Harleysville, PA 19438
(215-723-6051)</p> <p>18. Bondex International, Inc.
3616 Scarlet Oak Blvd.
St. Louis, MO 63122
(314-225-5001)</p> <p>19. Durok Building Materials, Inc.
Hastings-on-Hudson, NY 10706
(914-478-1923)</p> <p>20. Permagile Corp. of America
101 Commercial Street
Plainview, NY 11803
(516-433-1100)</p> <p>21. See 6.</p> <p>22. Preco Chemical Corp.
55 Skyline Drive
Plainview, NY 11803
(800-645-1237) Toll Free,
or (516-935-9100)</p> <p>23. See 12.</p> |
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TABLE A3 (cont'd)

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|---|---|
| 24. See 16, 17. | 40. Dur-A-Flex, Inc.
100 Meadow Street
Hartford, CT 06114
(203-246-5200) |
| 25. Steelcote Mfg. Co.
3418 Gratiot Street
St. Louis, MO 63103
(314-771-8053) | 41. See 19. |
| 26. L&M-Surco Mfg., Inc. | 42. See 12. |
| 27. P. O. Box 35472 | 43. See 31. |
| 28. Dallas, TX 75235
(214-631-3750) or
P. O. Box 105
South River, NJ 08882
(201-254-4830) | 44. Miracle Adhesives Corp.
250 Pettit Ave.
Bellmore, Long Island, NY 11710
(516-221-0950) |
| 29. United States Ceramic Tile Co.
1375 Raff Rd., S.W.
Canton, OH 44710
(216-477-8511) | 45. See 16, 17. |
| 30. USM Corp., Upco Chemical Div.
4805 Lexington Ave.
Cleveland, OH 44103
(216-881-0033) | 46. See 29. |
| 31. Cambridge Tile Mfg. Co.
Cam Products Div.
P. O. Box 15071
Cincinnati, OH 45215
(513-821-4180) | 47. See 31. |
| 32. See 12. | 48. See 44. |
| 33. See 16, 17. | 49. See 16, 17. |
| 34. | 50. See 29. |
| 35. See 26, 27, 28. | 51. See 31. |
| 36. See 29. | 52. See 19. |
| 37. See 30. | 53. |
| 38. Acme Chemicals Division
Allied Products Corp.
P. O. Box 1404
New Haven, CT 06505
(203-562-2171) | 54. See 44. |
| 39. See 31. | 55. |
| | 56. See 30. |
| | 57. See 2. |
| | 58. See 19. |
| | 59. Selby, Battersby and Company
5220 Whitby Ave
Philadelphia, PA 19143
(215-474-4790) |
| | 60. See 25. |

TABLE A3 (cont'd)

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|-------------------------------------|--------------------------------------|
| 61. See 7. | 79. Chem-Masters Corp. |
| 62. | 477 Industrial Parkway |
| | Chagrin Falls, OH 44022 |
| | (216-247-4277) |
| 63. Anti-Hydro Waterproofing Co. | 80. See 19. |
| 64. 265-277 Badger Ave. | |
| Newark, NJ 07108 | |
| (201-243-5440) | |
| 65. See 2. | 81. Rubber and Plastics Compound |
| | Co., Inc. |
| 66. Glidden Coatings & Resins | 25-20 43rd Ave. |
| 67. Division of SCM Corporation | Long Island City, NY 11101 |
| Cleveland, OH 44115 | (212-392-6780) |
| (216-771-5121) | |
| 68. Mobile Chemical Co. | 82. Sonneborn, Div. of Contech, Inc. |
| 69. Maintenance and Marine Coatings | 83. 383 E. 16th Street |
| 70. 901 North Greenwood Ave. | 84. Chicago Heights, IL 60411 |
| Kankakee, IL 60901 | (312-747-8700) |
| (815-933-5561) | |
| 71. See 6. Distributor is: | 85. See 26, 27, 28. |
| Tremco Manufacturing Co. | |
| 10701 Shaker Blvd. | 86. Thiokol Chemical Corp. |
| Cleveland, OH 44104 | P. O. Box 1296 |
| (216-229-3900) | Trenton, NJ 08607 |
| | (609-396-4001) |
| 72. See 22. | 87. See 7. |
| 73. See 25. | 88. See 71. |
| 74. Missouri Paint and Varnish Co. | 89. American Elastomers Co., Inc. |
| 5125 North Second St. | 400 Linden Ave. |
| St. Louis, MO 63147 | Wilmette, IL 60091 |
| (314-241-6370) | (312-251-1552) |
| 75. Wilbur and Williams Div. | 90. See 79. |
| Carpenter-Morton Co. | 91. |
| 376 Third Street | |
| Everett, MA 02149 | 92. Compotite Shower Pan |
| (617-387-5700) | P. O. Box 26188 |
| | Los Angeles, CA 90026 |
| 76. See 63, 64. | (213-483-4444) |
| | 93. See 14. |
| 77. Carlisle Tire and Rubber Div. | 94. Noble Company |
| 78. Carlisle Corp. | 614 Monroe Street |
| Carlisle, PA 17013 | Grand Haven, MI 49417 |
| (717-249-1000) | (616-842-7844) |

TABLE A3 (cont'd)

95. Sandell Manufacturing Co., Inc.
84 Sherman Street
Cambridge, MA 02140
(617-491-0540)
96. See 82, 83, 84.
97. See 71.
98. Generally available.
99. Hilliard Chemical Company
100. St. Joseph, MO 64502
101. (816 233-1321)
102. See 26, 27, 28.
103. Formica Corporation
120 East Fourth Street
Cincinnati, OH 45202
(513-721-1000)
(513-786-3400) Develop. Dept.
104. Blake Division
Hoffman Specialty Mfg. Corp.
1700 West 10th Street
Indianapolis, IN 46207
(317-632-7546)
105. Frank Pattern and Mfg.
10852 Kyle Street
Los Alamitos, CA 90720
(213-596-8510)
106. Josam Manufacturing Co.
Michigan City, IN 46360
(219-872-5531)
107. Nalgene Piping Systems Div.
Nalge Co.
75 Panorama Creek Drive
Rochester, NY 14625
(716-586-8800)
108. R&G Sloane Manufacturing Co., Inc.
7606 N. Clybourn Ave.
Sun Valley, CA 91352
(213-875-0160)
Cleveland, OH
(216-524-8600)